

A pretreatment region low.

#### REMARKS

Reconsideration and allowance are respectfully requested.

The above amendments address the issues raised in the office action. No new matter has been added. Entry and allowance are requested.

Since Claim 21 has not been rejected in the Office Action, Applicant understands Claim 21 is allowable.

Claims 1-4, 6-7, 9, 11-14, 16-19, 22 and 23 describe unique features and are patentable over Selep et al. Claims 5, 8, 10, 15 and 20 are also patentable over Selep.

The Examiner relies on Selep et al. as teaching "sweeping the coal with nitrogen followed by sweeping with product gas and then with steam before gasification of the coal," (Office Action, page 4). The Examiner adds that any structural element or process not taught by Selep et al. "would have been obvious to add such elements and steps to aid in gasification of the coal," (Office Action, page 4).

Claim 1 describes a pretreatment vessel for holding a bed of coal particles, an enclosure for preventing air from contacting the bed of coal particles, and a very low oxygen sweep gas or a vacuum for removing the oxygen released from the heated coal particles in the pretreatment region.

Claim 2 adds to claim 1 an inlet and outlet on the pretreatment vessel for adding and removing coal particles.

Claim 3 adds to claim 1 a pyrolysis retort with transfer passages for transferring heated coal particles from the pretreatment vessel to the pyrolysis retort.

Claim 4 adds to claim 1 the pretreatment vessel serving as a dryer for removing moisture from the coal particles.

Claim 6 adds to claim 1 an inlet to the pretreatment vessel for contacting the coal particles with a sweep gas of low oxygen content, and a gas outlet for removing the sweep gas before the oxygen extracted from the coal particles builds up in the sweep gas and inhibits the deoxidation process.

Claim 7 adds to claim 6 a source for supplying low oxygen flue gas as an oxygen removal sweep gas to the coal particles.

Claim 9 adds to claim 6 a source for supplying carbon monoxide to the coal particles and removing oxygen from the coal particles with the carbon monoxide.

Claim 11 defines a process for heating the bed of coal particles to a temperature below the coal pyrolysis temperature range, preventing air from contacting the bed of coal particles, and removing oxygen released from the heated coal particles before subjecting the coal to pyrolysis.

Claim 12 adds to claim 11 inputting coal particles to the pretreatment vessel and outputting coal particles from the vessel.

Claim 13 adds to claim 11 transferring heated coal particles from the pretreatment vessel to a pyrolysis retort while preventing entry of air.

Claim 14 adds to claim 11 removing moisture from the coal.

Claim 16 adds to claim 11 contacting the coal particles in the bed with an oxygen removal gas, and removing the oxygen removal gas with the oxygen removed from the coal particles.

Claim 17 adds to claim 16 supplying low oxygen flue gas as the oxygen removal gas to the bed of coal.

Claim 18 adds to claim 11 collecting non-condensable combustible gases from coal pyrolysis, burning the collected non-condensable combustible gases for heating the bed of coal, and supplying partially combusted collected non-condensable gases from the burner to the bed of coal particles for removing oxygen from the bed of coal particles.

Claim 19 adds to claim 16 supplying carbon monoxide to the bed of coal particles and removing oxygen from the coal particles with the carbon monoxide.

Claim 22 describes providing a pretreatment vessel for holding a bed of coal particles, heating the bed of coal particles to a temperature below the coal pyrolysis temperature range in a preheater, preventing air from contacting the bed of coal particles in an enclosure around the vessel, and removing the oxygen released from the heated coal particles and transporting it away from the enclosure for keeping the partial pressure of oxygen in the pretreatment region low.

Claim 23 describes contacting a bed of coal particles with oxygen removal gas, removing the oxygen removal gas with oxygen removed from the coal particles, and transferring the pretreated

coal to a pyrolysis retort in the absence of air.

Selep has no apparatus for preheating coal, nor an apparatus for removing oxygen from the coal. Selep describes passing coal through two rotary gas locks prior to gasification. Nitrogen is supplied to the inlet of the first rotary gas lock to prevent "oxygen-containing ambient air from entering first rotary lock" (col. 5, lines 14-15). After the nitrogen purge, the transferring compartments of the second rotary gas lock are swept with product gas to exhaust "buffer gas from said material transferring compartments" (column 7, lines 11-12).

While Selep may mention the use of a cover-gas, or buffer-gas, such as nitrogen or combustion products as a means for keeping air out of the system, the prime objective of Selep is to provide a means for raising the pressure of the gas-borne coal particles to the high pressure required for the coal conversion process. That has nothing to do with the claimed invention.

In the present invention, coal is supplied to a preheater. The unique pretreatment of the invention serves to remove oxygen, moisture and the majority of the fine particles inherent in the coal before it reaches the gasification stage. A sweep gas is used to carry off the released oxygen, moisture and fines prior to moving the coal to the pyrolysis stage. The unique prior removal of oxygen from the coal, that would otherwise have been produced in and hindered the pyrolysis stage, results in the production of a liquid hydrocarbon with a much lower viscosity. Nothing in Selep describes, teaches, or suggests those claimed

features. Thus, the reference cannot anticipate nor render obvious any claim.

Furthermore, the Examiner states that Selep may fail "to teach any structural element or process step of the above mentioned claims" (Office Action, page 4). The Examiner then proceeds to state that it would have been "obvious to add such elements and steps to aid in gasification of the coal" (Office Action, page 4). In making such a statement, the Examiner fails to rely on any prior art as specifically called for in § 103(a). 35 U.S.C. 103(a) provides that differences must be found between "... the subject matter sought to be patented and the prior art..." (emphasis supplied).

Claims 5, 8, 10, 15 and 20 also describe unique features that are patentable over the prior art including Selep.

Despite admitting that Selep et al. "does not teach using vibrating the coal or using ceramic balls to aid in heating" (Office Action, page 4), the Examiner then holds, "it would have been obvious to a routineer in the art to use vibration and ceramic balls in the device of Selep et al. to aid in mixing and preheating of the coal as these are known methods of mixing and preheating" (Office Action, page 4). The Examiner fails to offer any prior art on which to base the assertion as required by § 103(a). Thus, nothing in the references teach or suggest the claimed features.

Lacking any teaching or even any prior art to testify to such a holding, it is not understood how one of ordinary skill

could arrive at the present invention. Of course, like the Examiner, the ordinary skilled artisan could use the present invention as a guide for hindsight reconstruction. However, that cannot substantiate any obviousness rejection.

It has been widely recognized that it is desirable to exclude air from pyrolysis processes, and such action is either explicitly or implicitly included in six of the seven patents cited by the Examiner (in the seventh, Johnson deliberately introduces air, stating in line 9, column 10 of his patent, quote, "gasifying said fuel by introducing air into said gasification vessel").

However, none of the cited patents recognizes the problem (as uniquely done in the present application) that oxygen can be given off from the coal itself in the course of the pyrolysis process, and that this oxygen can badly degrade the quality of the liquid hydrocarbons produced, apparently inducing them to polymerize into a viscous black tar.

While those patents include mention of the use of a cover-gas, or buffer-gas, such as nitrogen or combustion products as a means for keeping air out of the system, the prime objective of five of each of the prior art patents (Selep, van der Burgt, Mink, Dewitz, and Schmit) is to provide a means for raising the pressure of the gas-borne coal particles to the high pressure required for the coal conversion process.

The prime objective of the other two patents cited (Johnson and Cordier) is the drying of the coal before feeding it to the

main process. There is no mention of removal of loosely-bound oxygen from the coal, or its deleterious effects on the product liquid.

Primarily two different coal conversion processes are involved in the seven prior patents: coal pyrolysis in which the polymers in coal are broken down by heating to yield much lower molecular weight hydrocarbons; and the two-centuries-old "water gas process" in which sufficient oxygen is supplied for combustion to heat the coal to a high temperature to produce CO and hydrogen that can then be used as a gaseous fuel or synthesized to give a liquid fuel such as an alcohol.

The latter process was the basis for the German plants of WWII. That process has an energy efficiency less than 50% and requires a very complex and expensive plant. The Johnson patent is aimed at the latter application.

The long-standing problem that the loosely-bonded oxygen in coal can severely degrade the quality of the liquid product from a pyrolysis process is not even recognized in the art and, therefore, its solution is non-existent and cannot be anticipated nor rendered obvious by the prior art.

That the long-standing problem identified above has dogged the industry remains a fact, because its seriousness is apparent from the fact that every pilot plant in the U.S. that has been designed to produce motor fuel from coal has failed to yield a liquid of an acceptable quality.

The most successful of those pilot plants, that at Gillette,

WY, had to be finally shut down in 1997 after over 10 years of intensive effort to improve the quality of the liquid product. The best liquid it could ever produce was much inferior to No. 6 fuel oil, i.e., residual fuel oil, the waste product from petroleum refineries.

One should recognize ab initio that very able coal chemists and chemical engineers have worked on these problems for over 100 years, not just in the U.S. but in England, Germany, France, Russia, Australia, South Africa, Japan, China, among others.

There is nothing in the extensive literature that provides any solution to the long-standing problems faced by the industry and which are the key points of the present application, namely:

first, there is loosely-bound oxygen in coal that will be released in a coal pyrolysis process and degrade the quality of the product liquid so badly that it is of little value commercially;

second, a relatively simple and inexpensive process has been devised for removing this loosely-bound oxygen from coal before feeding it to a pyrolysis process so that the product liquid will be roughly comparable to Commercial No. 2 fuel oil. The prior art misses these two key points which have been uniquely pointed out by the present invention.

The present application is for a coal pretreatment process that is effective in removing the loosely-bonded oxygen from the coal, thus making it possible to employ a coal pyrolysis process and obtain a good quality low viscosity fuel oil (with, for

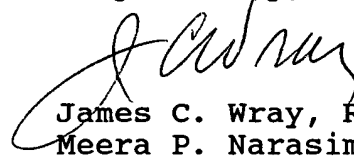


example, about the same viscosity as No. 2 fuel oil), and do this with an optimum high energy efficiency at a moderate cost. While the most beneficial temperature and treatment time may vary from one coal to another, appropriate conditions for this pretreatment process is determined by monitoring the off-gas from the treatment process and selecting conditions that reduce the oxygen content of the off-gas (for example, to less than 0.0001 parts of oxygen).

Nothing in the prior art teaches or suggests the claimed features. Thus, the present claims cannot be anticipated nor rendered obvious over any reference.

Since Applicant has presented a novel, unique and non-obvious invention, reconsideration and allowance of all the claims are requested.

Respectfully,



James C. Wray, Reg. No. 22,693  
Meera P. Narasimhan, Reg. No. 40,252  
1493 Chain Bridge Road, Suite 300  
McLean, Virginia 22101  
Tel: (703) 442-4800  
Fax: (703) 448-7397

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